

LIII. *The Quantity of the Sun's Parallax, as deduced from the Observations of the Transit of Venus, on June 3, 1769: By Thomas Hornsby, M. A. Savilian Professor of Astronomy in the University of Oxford, and F. R. S.*

Read Dec. 19, 1771. **T**HE uncertainty as to the quantity of the Sun's parallax, deduced from the observations of the transit of Venus in 1761 (whether it arose from the unfavourable position of the planet, so that a sufficient difference of time in the total duration of the transit was not, and indeed could not be, obtained from observations made at different places; or from the disagreement of the observations of different astronomers, which were to serve as terms of comparison) seems now to be entirely removed: and from the observations made in distant parts by the astronomers of different nations, and especially from those made under the patronage and direction of this Society, the learned of the present time may congratulate themselves on obtaining as accurate a determination of the Sun's distance, as perhaps the nature of the subject will admit.

The two following Tables give not only the observations themselves, but also the computed differences of time from which the parallax was deduced.

TABLE I.

Places.	Latitude.	Observers names.	Int. Cont. at Ingreſs	Int. Cont. at Egreſs	Obſ. Dur.
	° ' "		H. ' "	H. ' "	H. ' "
Wardhus.	70 22 36 N.	F. Hell.	9 34 10,6	15 27 24,6	5 33 14
Kola.	68 52 56 N.	M. Rumonſky.	9 42 4	15 35 23	5 53 19
Hudſon's Bay.	58 47 32 N.	{ M. Wales.	1 15 21,3	7 0 45,5	5 45 24,2
California.	23 3 37 N.	{ M. Dymond.	1 15 25,3	7 0 48,5	5 45 23,2
		Abbè Chappe.	0 17 27,9	5 54 50,3	5 37 32,4
K. George's Iſland.	17 28 55 S.	{ Capt. Cook.	21 44 15,5	3 14 13	5 29 57,5
		{ Mr. Green.	21 43 55,5	3 14 3	5 30 7,5
		Dr. Solander.	21 44 2,5		

TABLE II.

	Obſerved durations.	Difference of comp. durat.	Difference of obſerv. durat.	Sun's parallax.
	H. ' "	' "	' "	"
{ King George's Iſland.	5 29 52,5			
{ Wardhus.	5 53 14	23 31,36	23 21,5	8,639
{ Kola.	5 53 19	23 41,09	23 26,5	8,611
{ Hudſon's Bay.	5 45 23,7	15 51,90	15 31,2	8,511
{ California.	5 37 32,4	7 42,43	7 29,9	8,464
{ California.	5 37 32,4			
{ Wardhus.	5 53 14	15 48,93	15 51,6	8,724
{ Kola.	5 53 19	16 4,41	15 56,6	8,629
{ Hudſon's Bay.	5 45 23,7	8 9,47	8 1,3	8,555
{ Hudſon's Bay.	5 45 23,7			
{ Wardhus.	5 53 14	7 39,46	7 50,3	8,905
{ Kola.	5 53 19	7 49,19	7 55,3	8,813
Mean of all				8,650

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The second column of the second Table contains the observed duration, or interval of time, between the two internal contacts; the third contains the difference of each duration, deduced by computation upon a supposition that the Sun's parallax was $= 8'',7$ on the day of the transit; the fourth, the difference of that duration, as determined by actual observation: In the last column is given the horizontal parallax on the day of the transit, resulting from a comparison of the third and fourth columns.

In the above comparison, I have used Captain Cook's observation at the ingress, and a mean of his and Mr. Green's observations at the egress; because, upon a comparison of the observed times at the ingress and egress, made at the several places, when reduced to the center of the Earth, upon a supposition that the Sun's parallax on the day of the transit was $= 8'',65$, the difference of meridians, as deduced from Captain Cook's observation at the ingress, agrees much better with the same differences deduced from a mean of the two observations at the egress, than those derived either from the observation of Mr. Green, Dr. Solander, or even from a mean of all the three observations, as appears from the following comparison.

Observed times.
Effect of parallax.
Reduced times.

Wardhus.				California.			
Ingrefs.		Egrefs.		Ingrefs.		Egrefs.	
H.	"	H.	"	H.	"	H.	"
9 34 10,6		15 27 24,6		0 17 27,9		5 54 50,3	
+ 6 35,6		— 4 35,9		+ 24,9		+ 4 52	
9 40 46,2		15 22 48,7		0 17 52,8		5 59 42,3	
Kola.				Hudson's Bay.			
Ingrefs.		Egrefs.		Ingrefs.		Egrefs.	
H.	"	H.	"	H.	"	H.	"
9 42 4		15 35 23		1 15 23,3		7 0 47	
+ 6 37,4		— 4 45,1		+ 4 15,9		+ 0 38,7	
9 48 41,4		15 30 37,9		1 19 39,2		7 1 25,7	

Observed times.
Effect of parallax.
Reduced times.

Observed times.
Effect of parallax.
Reduced times.
Ditto at Wardhus.
Difference of meridians.

King George's Island.							
Ingrefs.				Egrefs.			
Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.	Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.
21 44 15,5	21 44 4,5	21 44 2,5	21 43 55,5	3 14 8			
5 40,4	5 40,4	5 40,4	5 40,4	+ 6 23,8			
21 38 35,1	21 38 24,1	21 38 22,1	21 38 15,1	3 20 31,8			
9 40 46,2	9 40 46,2	9 40 46,2	9 40 46,2	15 22 48,7			
12 2 11,1	12 2 22,1	12 2 24,1	12 2 31,1	12 2 16,9			

Reduced times at K. G. Id.
Ditto at California.
Difference of meridians.

Ingrefs.				Egrefs.			
Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.	Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.
21 38 35,1	21 38 24,1	21 38 22,1	21 38 15,1	3 20 31,8			
0 17 52,8	0 17 52,8	0 17 52,8	0 17 52,8	5 59 42,3			
2 39 17,7	2 39 28,7	2 39 30,7	2 39 37,7	2 39 10,5			

Reduced times at K. G. Id.
Ditto at Kola.
Difference of meridians.

Ingrefs.				Egrefs.			
Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.	Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.
21 38 35,1	21 38 24,1	21 38 22,1	22 38 15,1	3 20 31,8			
9 48 41,4	9 48 41,4	9 48 41,4	9 48 41,4	15 30 37,9			
12 10 6,3	12 10 17,3	12 10 19,3	10 10 26,3	12 10 6,1			

Reduced times at K. G. Id.
Ditto at Hudson's Bay.
Difference of meridians.

Ingrefs.				Egrefs.			
Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.	Capt. Cook.	Mean.	Dr. Solander.	Mr. Green.
21 38 35,1	21 38 24,1	21 38 22,1	21 38 15,1	3 20 31,8			
1 19 39,2	1 19 32,9	1 19 39,2	1 19 39,2	7 1 25,7			
3 41 4,1	3 41 15,1	3 41 17,1	3 41 24,1	3 40 53,9			

The near agreement of the difference of meridians between King George's Island and the four other places, as deduced from Captain Cook's observation at the ingress, and from a mean of his and Mr. Green's observations at the egress, sufficiently, I think, shew that the observed duration at King George's Island is at least $5^h 29' 52'',5$: And, from a comparison made in the same manner with the observations at Hudson's Bay, it might be shewn that the time of the egress is uncertain to a few seconds, owing, perhaps, to the haziness of the air peculiar to that climate, even at the altitude of 10 or 12 degrees.

By the end of the Sun's eclipse on the morning after the transit, the longitude of Wardhus from Paris, according to Father Hell, is $1^h 55' 6''$ E. of Paris, or $2^h 4' 22''$ E. of Greenwich: and, according to the observation of Mr. Rumovsky, Kola is $2^h 2' 55''$ E. of Paris, or $2^h 12' 11''$ E. of Greenwich. The point therefore at King George's Island, where the transit was observed, is $9^h 57' 53'',6$ $= 149^\circ 28' 24''$ W. of Greenwich; Vill St. Joseph in California is $7^h 18' 42\frac{1}{2}'' = 109^\circ 40' 37''$ W. of Greenwich; and Prince of Wales's Fort in Hudson's Bay $6^h 16' 49\frac{1}{2}'' = 94^\circ 12' 22''$ W. of Greenwich.

From the near agreement of the several results before found, which are independent of the knowledge of the longitude of each place, and affected only by the necessary error in observing, the accuracy of the observation made at the Cape of Good Hope in 1761, by Messieurs Mason and Dixon, is abundantly confirmed; by comparing which with
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the best observations made in the places whose longitudes were very nearly ascertained, the Sun's parallax on the 5th of June was found $= 8'',692^*$. And Mr. Pingré, notwithstanding the several arguments very speciously produced in favour of his own observation at the Island of Rodrigues, as represented in his learned Memoire on the Sun's Parallax, will probably be of opinion, that an error of one minute was committed in writing down the time of his observation, as was conjectured by many persons, as well as myself; a mistake to which the most experienced observer is sometimes liable, when at the time of observation the minute is nearly completed.

The parallax on the 3d of June being $8'',65$, the mean parallax will be found to be $= 8'',78$; and if the semidiameter of the Earth be supposed $= 3985$ English miles, the mean distance of the Earth from the Sun will be 93,726,900 English miles. And, as the relative distances of the planets are well known, their absolute distances, and consequently the dimensions of the Solar System, will be as follows.

	Relative distance.	Absolute distance.
Mercury,	387,10	36,281,700
Venus,	723,33	67,795,500
Earth,	1000,00	93,726,900
Mars,	1523,69	142,818,000
Jupiter,	5200,98	487,472,000
Saturn,	9540,07	894,162,000

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* See Phil. Transf. Vol. LIII. for the Year 1763. p. 491.